Amendments to the Specification

[0012] In an exemplary embodiment, apparatus for fiber length measurements from a tapered beard attached to a fiber sampler, includes a rectangular channel into which a tapered beard is drawn by a gas flow through the channel. The channel has two opposed major sides corresponding to channel width and length, and two opposed minor sides corresponding to channel height and length. One of said major sides takes the form of a transparent window, and an optical imaging device views the tapered beard through the transparent window for acquiring a two dimensional image of the tapered beard. A digital computer is connected to an output of the optical imaging device for storing two-dimensional image data and determining fiber amount as a function of one-dimensional distance x from the fiber sampler by averaging across the width of the tapered beard as imaged.

[0014] In yet another embodiment, a method for image based length measurement is provided. The method includes acquiring a two-dimensional digital image of a tapered beard of fibers, which beard has a length; employing a computer to analyze the digital image to determine fiber amount as a function of one-dimensional distance along the length of the tapered beard by averaging across the width of the tapered beard as imaged; and analyzing the determined fiber amount as a function of distance to produce a fiber length distribution.

[0062] FIG. 7A shows two ideal fibrograms for monodisperse, or monolength, fiber length distributions, having N fibers of all 0.5 inch or 1.00 inch length. (This does not mean that all fibers simply extend 0.5 inch or 1.00 inch from the needles, because the fibers are looped around and are locked to the needles. The needles engage the individual fibers at random distances along the fiber, and the two ends of each individual fiber can be at any distance from the needles.) [[OK]] More specifically, the ideal A_i are seen to be proportional to the

number of fibers in the tapered beard along the scan line 164 (across the tapered beard) at each distance x. Thus the ideal fibrogram for monodisperse (or monolength hereinafter) fiber length distributions consisting of all 0.5 inch fibers starts at 2N at x = 0 and falls linearly to 0 at x = 0.5 inch. Similarly, the ideal fibrogram for a monolength distribution having N identical 1.0-inch fibers starts at 2N at x = 0 and falls linearly to 0 at x = 1 inch.

[0066] It shall now be shown how double differentiation of corrected or calibrated A vs x responses enables direct determination of calibrated PDFs. That is, the method enables correction ~~enablescorrection~~ for non-ideal measurement issues, one of which, the peaking phenomenon, is discussed hereinabove. It will be appreciated that these methods apply to amount versus distance Fibrograms resulting from air flow (L_a) [[(La)]], optical extinction (L_o) [[(Lo)]] and to the instant image-based L_i [[Li]]. Experimental results reported hereinbelow for L_i [[Li]] confirm the performance.

[0071] 2. The actual A_i vs x fibrograms for the known length monolength groups are compared to the ideal case (e.g. FIG. 7A), [[OK]] which intersects the x axis at the monolength and the A_i axis at 2N. The comparisons are preferably by linear regression techniques which yield, for each monolength group, x and y axis intercepts at the known lengths and at 2N, respectively, and linear responses therebetween. Other "best-fit" or even graphical techniques may also be employed.

[0083] The following results are for staple standard materials provided by USDA/AMS, Memphis, Tennessee. ~~USDA/AMS/Memphis, TN.~~ FIG. 10 shows UHM_i from prototype image-based length measurement apparatus embodying the invention, L_i, versus HVI UHM, including half error bars of one standard deviation, for clarity. Average CVs are shown in the inset on

FIG. 10. Evidently, L_i performance, as measured by average CVs, is superior to that of the particular HVI used for these comparisons to produce the corresponding LFC data. This surprising and most favorable result appears to be generally valid.

[0087] FIG. 12 shows SFC for the USDA/AMS Staple Standards by four independent methods: Li methods embodying the subject invention, by HVI, by AFIS, and from a prediction equation based on UHM and LUI (from HVI or L_i) and developed by Knowlton et al, USDA/AMS, Memphis, Tennessee. ~~USDA/AMS/Memphis, Tennessee.~~ AFIS may be regarded as a reference method for SFC and the methods embodying the subject invention as a candidate reference method. It is important to note that the AFIS and L_i methods are based on completely different scientific principles and are therefore entirely independent of each other. The L_i SFC data reported are independent of any calibration cottons whatsoever. Further, the raw PDFs are seen to yield quite satisfactory results, without the rigorous calibration procedures enabled by the invention. The fact that the L_i and AFIS or AFIS-based SFC(w) levels are so close to each other is truly remarkable. As noted above, the L_i method has the potential to become a reference method for SFC and for LFC data products, particularly when the rigorous calibration procedures of the invention are applied.